Intraspecific Variation in the Wild Male Population, and its Potential Value in the Mass Rearing Program, of the Oriental Fruit Fly, *Bactrocera dorsalis* (Hendel) (Diptera: Tephritidae)

TOSHIYUKI NISHIDA[1] and ROGER I. VARGAS[2]

ABSTRACT. A new concept for improvement of quality of breeding stock used for mass-rearing of tephritid fruit flies for sterile release eradication programs is reported. According to this concept, high quality individuals are those that are numerically dominant in the wild population and, hence, they would be selected for breeding purposes. To recognize dominant variants among the wild males of the oriental fruit fly, *Bactrocera dorsalis* (Hendel), intraspecific differences were determined. A total of nine intraspecific variants were recognized. Out of these one labelled GHC was dominant in the dry, wet, and fringe habitats of this fruit fly.

KEY WORDS: Insecta, *Bactrocera dorsalis* (Hendel), variants, mass rearing.

Oriental fruit fly, *Bactrocera dorsalis* (Hendel), was introduced into Hawaii about 1945 (van Zwaluwenberg 1947) and quickly became a severe pest. The sterile insect release method is one of the options that can be used for its eradication (Steiner et al. 1970). An effective mass rearing method and a stock colony with desirable attributes are critical factors in an effective eradication program (Vargas 1989).

For many years the U.S.D.A. Tropical Fruit and Vegetable Research Laboratory has been trapping oriental fruit fly using methyleugnol baited traps. It has been observed that there is considerable variation in the color patterns among individuals in the wild population (Drew 1988). We are studying the incidence of these color variations in an effort to identify individuals that may possess attributes desirable in flies that are mass reared for sterile male release programs. The present paper reports the extent of color pattern variation and frequency of occurrence of individuals with various patterns in the wild population of the oriental fruit fly in Hawaii.

[1]Professor Emeritus, Department of Entomology, College of Agriculture and Human Resources, University of Hawaii, 3050 Maile Way, Honolulu, Hawaii 96822.
[2]Tropical Fruit and Vegetable Research Laboratory, Agricultural Reserch Services, U.S. Department of Agriculture, P.O. Box 2280, Honolulu, Hawaii 96804.

MATERIALS AND METHODS

Sampling the wild male population.

Traps baited with methyl eugenol + naled were used to capture oriental fruit fly males (Vargas et al. 1983). Traps were suspended on branches of trees and bushes about 0.5-2M off the ground. The contents of the traps were removed at intervals of 0.5-3 days, depending on the numbers captured. Males were collected from wet and dry areas of Oahu (Fig. 1) during the spring and summer months of 1984. The dry and wet areas corresponded respectively to the A and C vegetation zones of Ripperton and Hosaka (1942). The dry sampling areas utilized were in the backyards of homes located in the dry section of the island.

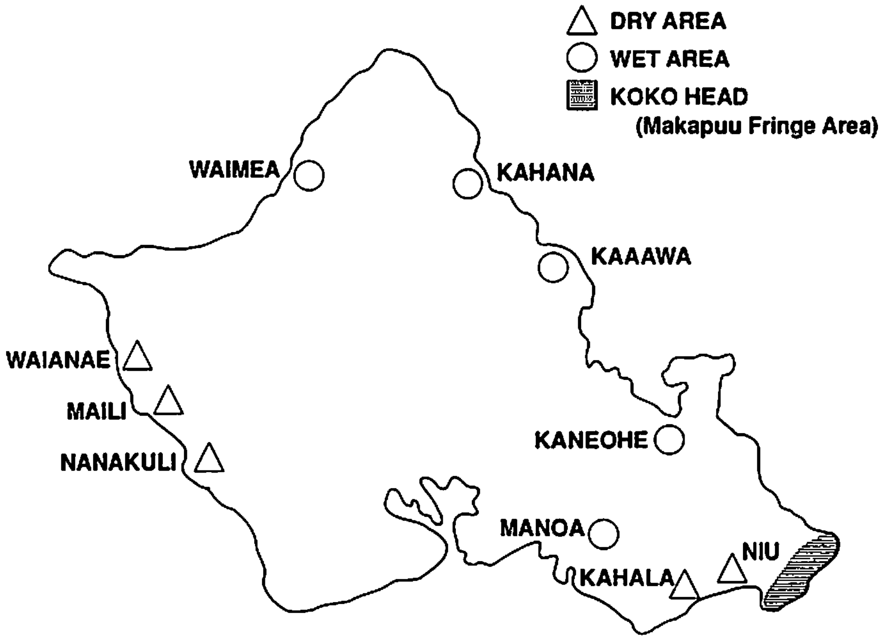

FIGURE 1. Map of Oahu showing areas where the males of the oriental fruit fly were collected.

Identification of the wild males.

The males captured in the traps were examined under magnifications of 16× and 20×. After examining hundreds of individuals, we noted small intraspecific differences in the dark bands of the dorsal side of the abdomen. The markings and terminology used in reference to them are shown in Fig. 2. In this paper individuals differing in the band configuration are called variants.

For identification purposes, the males sampled were divided into three groups based on the presence, absence, or interruption of cross band 1

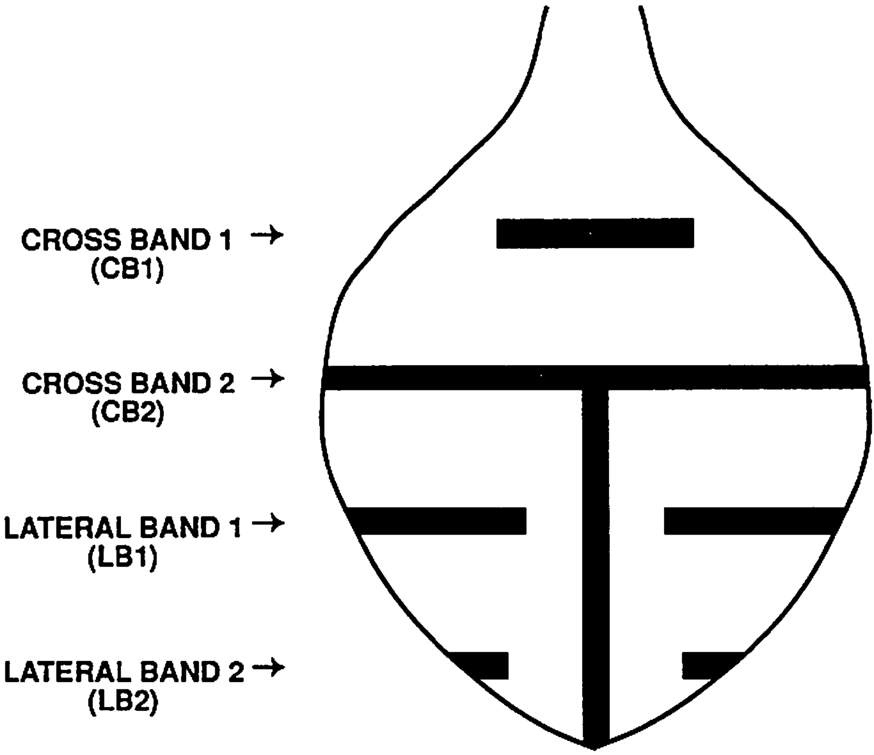

FIGURE 2. Diagram of the dorsal side of the abdomen of a male oriental fruit fly showing the cross and lateral bands.

(CB1, Fig. 2). The identification of variants within each group was made by use of diagrammatic keys (Fig. 3). The variants were labelled by group and variant designations. For example, in group I, there were three variants. They were labelled GIA, GIB, and GIC. Other variants in other groups were similarly labelled.

The so-called "white form" of the oriental fruit fly, which has been known in Hawaii for many years and which comprised less then 3% of the population, was not used, and was discarded when it appeared in the samples.

Determination of numerical dominance in the breeding areas.

For each trap location, the variants were identified and the numbers of each were recorded. In favorable habitats the traps captured literally thousands of males. In such cases sub-samples of 100-175 individuals were examined. In the unfavorable, sparsely populated areas where less than 100 were captured, all of the flies were examined.

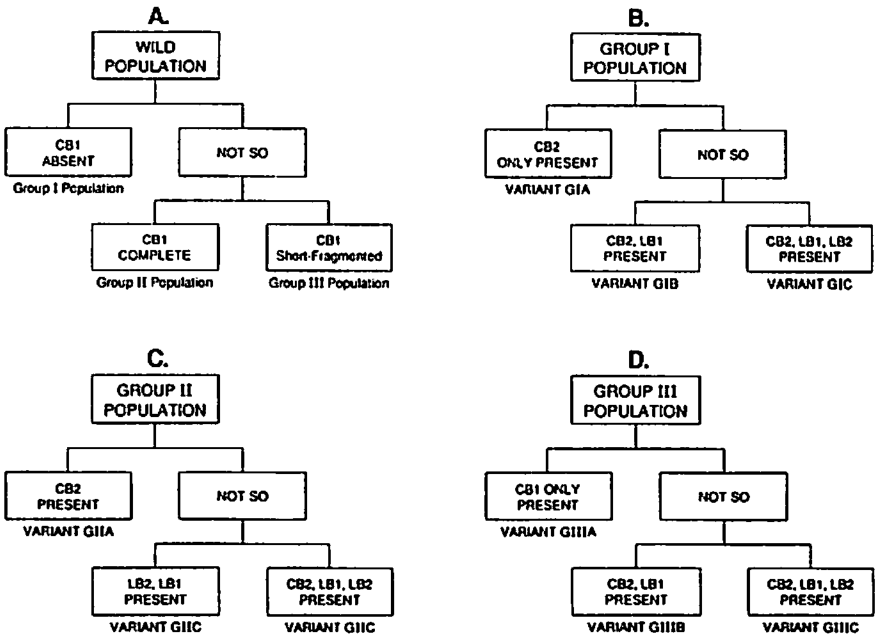

FIGURE 3. Diagrammatic key separating the wild males of the oriental fruit fly into groups and variants: A, to separate total wild male population into groups; B, C, and D to separate into group variants.

Determination of dominance in the non-breeding fringe areas.

Dominance data were obtained by placing 10 traps in the xerophytic vegetation on the hillsides, gulches, and coastal flats located on the dry southeast extremity of Oahu, (Fig. 1). This area extending from Koko Head to Makapuu was considered to be a non-breeding fringe area because of the low rainfall, and the absence of host plants, resulting in a sparse population of the oriental fruit fly. Because of the harsh environment only the strongest flies are expected to survive in this area.

RESULTS

Number of variants

From the samples taken in various habitats on Oahu we separated the male population into three groups, each with three variants. They are illustrated in Fig. 3.

Dominant variants

The variant spectra of the populations in the dry and wet habitats of Oahu are shown in Fig. 4. Both group and variant dominance are evident. Among the groups, group II was the most dominant. Among the variants, GIIC was dominant in the dry and wet habitats.

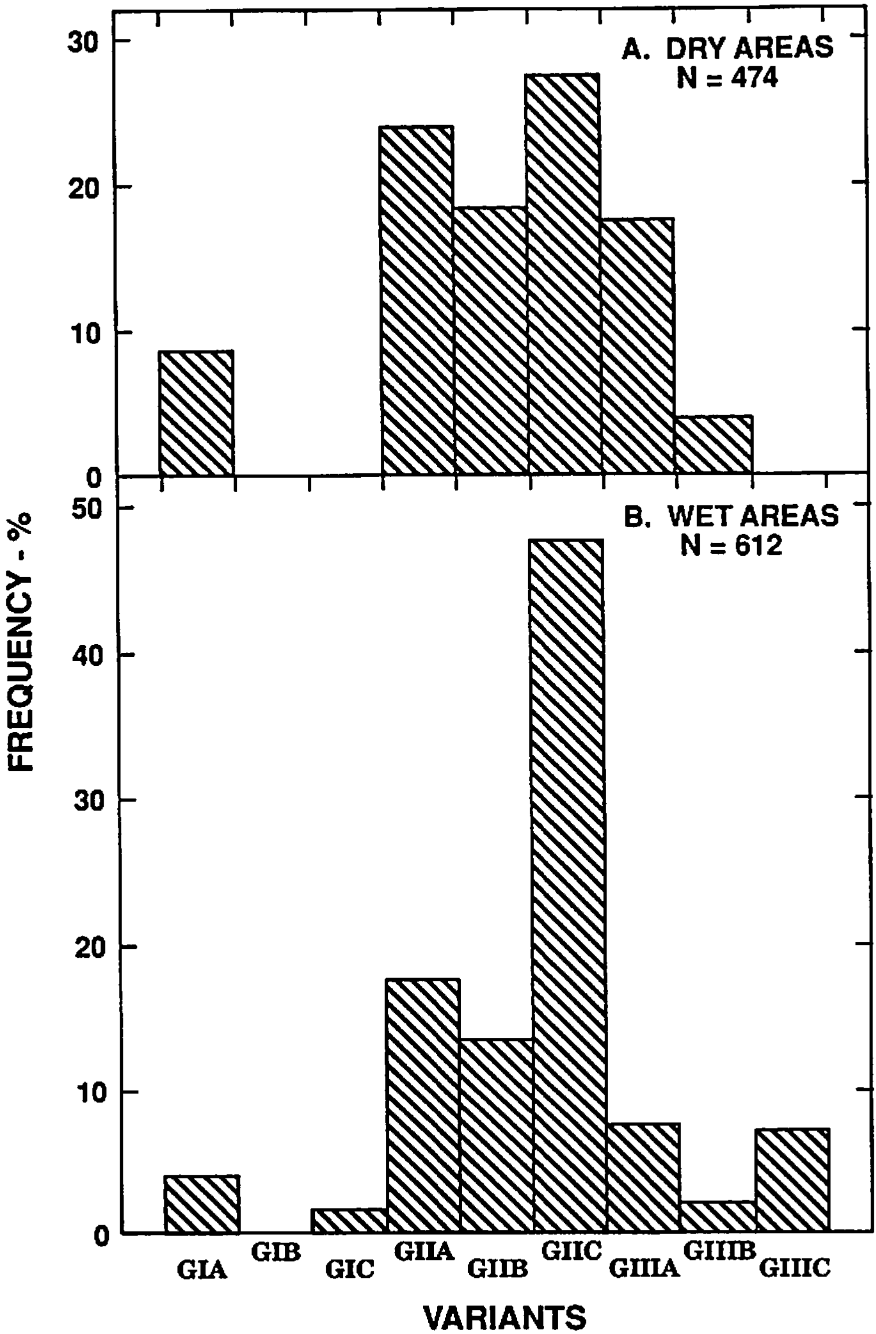

FIGURE 4. Variant spectra of the wild male population of the oriental fruit fly on Oahu: A, dry arids; B, wet areas.

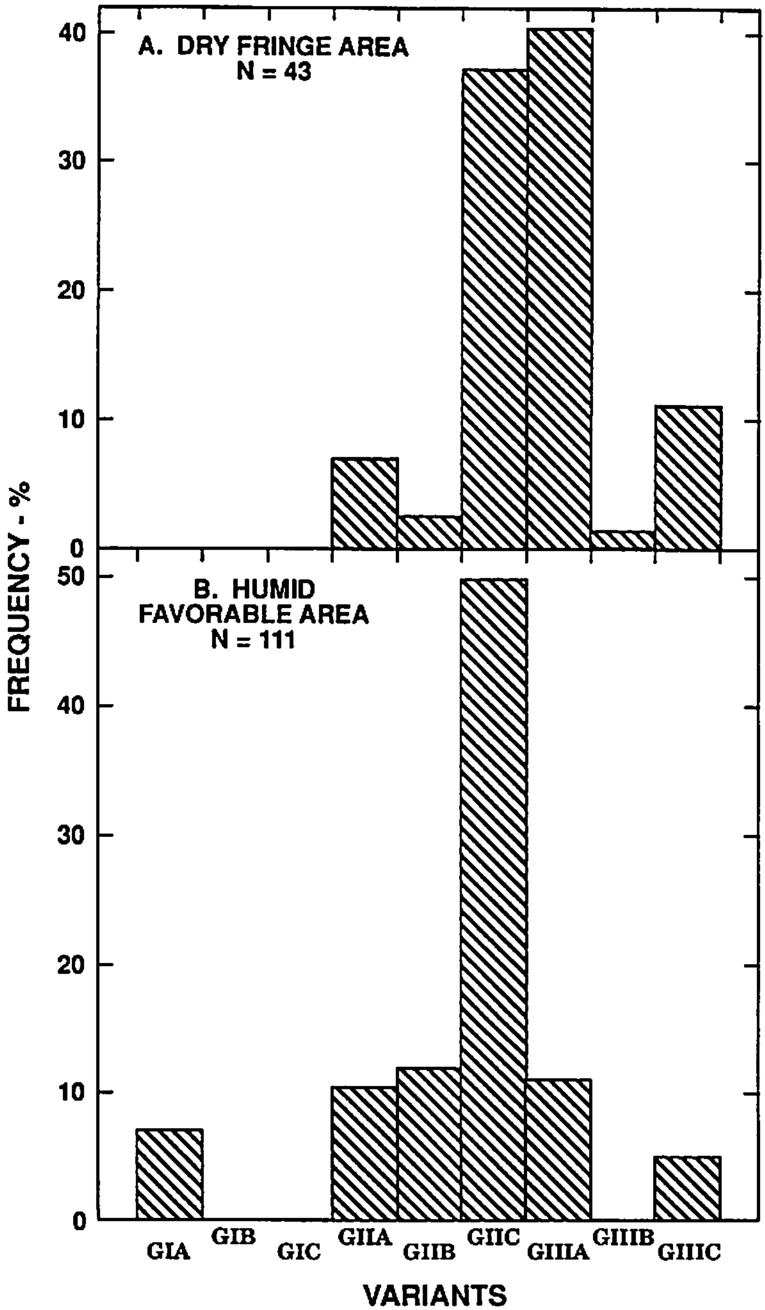

FIGURE 5. Variant spectra of the wild male population of the oriental fruit fly in the dry fringe areas of Koko Head and Makapuu and in the humid favorable areas of Kaneohe, Oahu.

Non-dominant varinats

As shown in Fig. 4, most of the non-dominant variants were in groups I and III. These non-dominant were not necessarily undersized or deformed. Many looked superficially like the variants in the dominant group. Some small individuals were present even in the dominant GIIC category.

Dominant variants in the fringe area

The variant spectrum from the fringe area, shown in Fig. 5, indicated that the variants, GIIC and GIIIA were the most dominant. Because of the absence of host plants, these variants were believed to be composed of individuals that had migrated into this dry area from other breeding areas. This suggests that these variants have high dispersal capabilities, as well as being resistant to dry conditions.

From Fig. 4 and 5 we can compare the variant spectra of the fringe and wet areas. It may be noted that the spectra narrowed as the habitat become less favorable. For example, the spectrum from Kaneohe, one of the best habitats, is broader than that of the dry fringe areas. This indicates that some variants cannot survive in the fringe areas while others can survive but are not dominant.

DISCUSSION

There are at least two approaches to the improvement of the quality of laboratory stock used for the mass-rearing of tephritid fruit flies: one, to search for and breed rare variants in the wild population; two, to search for and breed dominant variants in the wild population. From an ecological point of view the latter approach is the most logical, and it is the one we have used in this study. It is not apparent to us how mass-reared rare variants could be successful when released in the field. We assume that they are rare because of their inability to cope with the environment. By the same token, dominant variants are dominant because of their ability to cope with the environment.

Among the nine variants mentioned in this study, variant GIIC was the most dominant in the dry, wet, and fringe areas. Apparently, this variant has attributes that enable it to be successful on Oahu. There are other types of habitat on the other islands, such as the high elevation habitats on Maui, Hawaii, and Kauai. There are also deep humid gulches and canyons on Hawaii, Maui, Molokai, and Kauai. On nearly all islands there are dry desert-like habitats. Whether or not the variant GIIC is successful in all of these habitats needs to be determined.

This study was concerned with the search for the dominant male variants of the oriental fruit fly. Obviously, superior females are also important in the breeding of superior stock. Ultimately, our goal is to breed a laboratory stock with all the attributes of the dominant wild flies. Ideally, insectary-reared flies should be able not only to compete, but also should be able to move in and occupy all habitats occupied by the wild population.

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